23

LIMIT PARKING FACILITIES AT NEW SUBURBAN EMPLOYMENT SITES

Definition:

This TCM would restrict parking at new suburban employment sites to that required to satisfy the APO target under the Employer Trip Reduction Program. In and of itself, such restrictions could ensure that associated sites would meet their AVO targets, assuming spillover possibilities were limited.

Travel and Emissions Analysis:

This measure was evaluated using a sketch planning methodology to estimate the number of vehicle trips that would be eliminated by selective constraints in the supply of new parking. This estimate of trip reduction was then related to the HBW trip table through manual matrix adjustment.

The following steps were followed:

1. First, it was assumed that "suburban" parking would refer to facilities in the two outer AVO zones -- AVO 3 and AVO 4 -- established for the ETRP analysis. Geographically, this corresponds to the following counties and planning districts:

AVO Zone	County	Planning Districts
3	Delaware	13 - 18
	Chester	19
	Montgomery	30-35,37
	Bucks	46,48,50,51
4	Chester	20-29
	Montgomery	36,38-39
	Bucks	40-45,47,49

2. To approximate the increase in demand for new parking that would occur between 1994 and 1996, the increase in employment was estimated from DVRPC employment forecasts:

County	1990 Employment	1996 Employment	Change: 1994-96	Percent Increase
Delaware	230,450	237,680	2,386	1.03
Chester	197,740	206,480	2,884	1.46
Montgm.	457,449	487,508	10,020	2.19
Bucks	245,340	265,564	6,408	2.61

3. This increase in employment was used as a growth factor to estimate the increase in daily home based work trips that would occur between 1994 and 1996.

County	1996 HBW Pers. Trips	1994-6 % Increase	New P-T 1994-96
Delaware	343,474	1.03	3,537
Chester	305,861	1.46	4,466
Montgm.	694,872	2.19	15,218
Bucks	378,200	2.61	9,871

4. The increased parking demand that would be exerted by these additional HBW trips was estimated by calculating the number of vehicle trips that these person trips would generate, using current vehicle trip/person trip ratios for each county (these ratios were determined from model data at a planning district level). Increase in parking demand would be equal to 1/2 of the new daily vehicle trips:

County	Curr. VT/PT Ratio	1994-96 Per. Trips	Projected Veh. Trips	Parking Demand
Delaware	0.84	3,537	2,971	1,486
Chester	0.87	4,466	3,885	1,943
Montgm.	0.86	15,218	13,087	6,544
Bucks	0.88	9,871	8,686	4,343

5. It would then be assumed that this new parking demand would be constrained *not entirely, but to a new parking ratio that would limit parking to rates consistent with the trip reduction requirements of ETR -- namely, if ETR requires a 23.3% reduction in current vehicle trip making in these zones, then parking would need to be constrained to yield a VT/PT ratio which is 23.3% less than the current VT/PT.*

28

COMPREHENSIVE BICYCLE IMPROVEMENTS IN THE REGION THAT WOULD CAPTURE 5% OF AUTO WORK TRIPS WITH A LENGTH OF 5 MILES OR LESS

Definition:

This measure would determine the effectiveness of attracting a higher percentage of work trips 5 miles or less to bicycle.

Travel and Emissions Analysis:

This analysis was performed using sketch planning techniques.

1. The current share of work trips made by bicycle was determined from 1990 NPTS data. In urbanized areas with a population of 1 million or more, with rail transit, the percentage of regional HBW trips made by bicycle is 0.27%. This figure concurs with findings of the National Bicycling and Walking Study: *Case Study No. 1: Reasons Why Bicycling and Walking are not Being Used More Extensively as Travel Modes.*

   An analysis of DVRPC trip distributions by trip length indicates that 36% of all HBW person trips are 5 miles or less. If we assume that all bicycle trips are 5 miles or less in length, then the bicycle share of HBW trips $\leq$ 5 miles = 0.27% $\div$ .36, or 0.75%.

2. Since specific bicycle improvement projects could not be assessed, bicycle use rates for work found in metro areas that had reasonably active bike programs, including facilities, were copied from the National Bicycling Study cited above. These areas (Tucson, Palo Alto, Seattle, Phoenix, Minneapolis, and San Diego) had an average bicycle use rate of 2.2%. The regional bicycle work trip goal was set to 2.2%, which equals 5.8% of trips under 5 miles.

3. The task is to increase bicycle trips $\leq$ 5 miles to 5.8%, less the existing rate of 0.75%, which is a net increase of 5%, or 79,185 daily bike trips.

4. All interchanges (O-D pairs) in HBW trip tables with trip lengths of 5 miles or less were selected. The number of trips and modal split was determined. The 79,185 new bicycle trips were pulled from the total person trip population above, in proportion to population.

5. Once the number of person trips for each O-D pair to be converted to bicycle is known, the trips are then further proportioned out of existing modes according to the existing share.

6. This manipulation is done for all affected O-Ds pairs, and the results are used to create new HBW trip tables. These trip tables are merged with total travel, assigned to the highway

network, and run through PPAQ for emissions.

Cost Methodology:

This measure would construct the required bicycle facilities to capture 5% of auto work trips with a length of 5 miles or less. The calculation of the capital cost of additional bicycle facilities was taken from the City of Chicago, CATS Conrail Bikeway Phase I Study, using only the engineering and construction costs. Using a 20-year amortization and an 8% discount rate, the cost per bicycle mile traveled is $0.13. The transit costs were calculated using the same methodology as in TCMs 9, 10, and 11. The private cost would include the cost of providing bicycle lockers at the place of employment. Each bicyclist would have a bike locker available at their work place. The cost of the bicycle lockers was $1,000 apiece (from CATS study), amortized over ten-years at a discount rate of 8%. Commuters will use biking as an alternate mode for only four months of a year.

29

COMPREHENSIVE BICYCLE IMPROVEMENTS IN THE REGION THAT WOULD CAPTURE 5% OF ACCESS TRIPS OF 5 MILES OR LESS FOR WORK PURPOSES TO 14 SELECTED RAIL STATIONS

Definition:

This measure would determine the effectiveness of drawing a higher percentage of persons within 5 miles of a rail station to access that station by bicycle.

Travel and Emissions Analysis:

This analysis was performed using sketch planning techniques.

1. Fourteen rail stations were identified which were felt to be likely candidates for access/utilization improvements directed at the bicycle mode. These stations are listed below, along with their current usage (taken from 1991 SEPTA Rail Passenger Survey):

Station	District	Inbound Boardings	% Work (Peak)	Riders Peak	New Bike Riders
Elwyn	17	329	.903	659	34
Media	17	401			
Langhorne	49	377	.908	342	17
Somerton	12	484	.935	452	23
Jenkintown	32	1082	.915	990	50
Levittown	50	456	.861	393	20
Torresdale	48	672	.945	635	32
Fox Chase	11	1050	.903	948	47
Paoli	19	1185	.908	1076	54
Bryn Mawr	34	916	.826	756	38
Overbrook	4	450	.878	395	20
Ambler	31	661	.875	579	29
East Falls	9	278	.817	617	31
Wyndmore	9	477			

The number of new bike riders shown above is multiplied by 2 to get daily bike trips.

2. The rail survey suggests that the current average bicycle access rate to these stations is about 1%. It is assumed that the share of persons within a 5 miles radius accessing the station by bicycle is increased to 5 percent of all trips. It is further assumed that improved access by bicycle will not affect the total trip mode split (to the ultimate destination) by shifting more

people to rail transit, but will only help to pull current private vehicle users out of short vehicle access trips in the vicinity of station.

3. For each station/district, all adjacent zone pairs with trip lengths of 5 miles or less were arrayed. The number of bicycle trips calculated above were extracted from current vehicle and transit trips in proportion to the person trips for each station area.

4. All of the adjustments were compiled into a single new HBW trip table, merged with total trips, assigned to the network, and run through PPAQ for emissions.

Cost Methodology:

This measure would attract 5% of work destination rail access trips $\leq$ 5 miles onto bicycles. The methodology was the same as in TCM 28, except that the bicycle lockers would be a public cost at rail stations. Again, bicycle trips will be used to access rail stations for only four months of the year.

30

COMPREHENSIVE BICYCLE IMPROVEMENTS IN THE REGION THAT WOULD CAPTURE 5% OF NON-WORK TRIPS WITH A LENGTH OF 5 MILES OR LESS

Definition:

This measure would determine the effectiveness of attracting a higher percentage of non-work trips less than or equal to 5 miles to bicycle.

Travel and Emissions Analysis:

This analysis was performed using sketch planning techniques.

1. The current share of non-work bicycle trips was estimated from the 1990 NPTS data to be 0.89% for areas with a population over 1 million, with rail transit.

2. Set the goal for non-work trips. If the increase due to bicycle improvements for work trips was 1.93% (2.2% - 0.27%) regionally, and 5% for trips under 5 miles, then seek to increase non-work bicycle trips by 1.93%. (1.93% x 13,532,122 non-work person trips = 261,170 new bicycle trips).

3. These 261,170 new bicycle trips were taken entirely from district-to-district interchanges (O-D pairs) where trip lengths are 5 miles or less. The base for this manipulation is 7,741,288 trips. The 261,170 bicycle trips were taken in proportion to O-D person trips first, and then from existing modes within the O-D pair in proportion to the current mode split.

4. New regional non-work trip tables reflecting these adjustments were formulated, merged with other travel (HBW), and run through a new network assignment. The new assignments were processed with PPAQ to estimate emissions.

Cost Methodology:

This measure would attract 5% of the non-work trips with a length of 5 miles or less to bicycle. The methodology is similar to TCMs 28 and 29, except that the bicycle lockers would be privately funded and used four times per day instead of once a day. Also, non-peak transit headways and service are not adjusted to reflect a reduction in ridership since the headways are policy driven and not capacity driven. However, transit revenue is reduced to reflect a drop in ridership.

31

REMOVAL OF PRE-1980 VEHICLES

Definition:

This TCM would attempt to eliminate half of all cars built before 1980 that are still in service. These vehicles produce emissions that are many times those of vehicles manufactured after 1980.

Travel and Emissions Analysis:

Assumptions:

- Only emissions rates will be affected. No changes in travel will result.
- Registered vehicles in the region will remain constant.
- Vehicle age distribution closely parallels the corresponding VMT values.

Procedure:

The input vehicle age distribution data for running MOBILE5a was adjusted to reflect the implementation of this measure. MOBILE5a was run and the emissions effects calculated.

Cost Methodology:

This measure purchases pre-1980 vehicles from private owners. The cost per vehicle purchased was $700, plus the public administration fee of $50 per vehicle. The purchase price was not amortized.

32

REDUCTION IN COLD STARTS

Definition:

This TCM would attempt to eliminate 5% of all vehicle cold starts across the region through a concerted public education program.

Travel and Emissions Analysis:

Assumptions:

- A public education program can be successful in eliminating 5% of cold starts.
- 10% of the total reduction in cold starts will come from people foregoing their normal trip. This results in a 0.5% drop in trips and VMT (=10% * 5%). The other 90% reduction in cold starts will come from changes in trip patterns and scheduling and presumed to have no net impact on trips or VMT. All of this 90% reduction would come from HBO and NHB trips proportionally (70% vs. 30%).
- The program will only affect vehicle trips produced within the Pennsylvania portion of the DVRPC region. Daily vehicle trips produced in Pennsylvania portion are:

HBW	2,134,050
HBO	3,765,222
NHB	2,059,180
TOT	7,958,452

- The education program only affects personal travel and the resulting change in trips is not large enough to affect average highway speed.
- Average trip lengths by purpose (miles):

HBW	8.0
HBO	5.6
NHB	5.0

- Proportion of trips that are cold starts:

HBW	90%
HBO	50%

NHB 40%

Based on the assumptions stated above, the reduction of cold starts and the corresponding VMT was computed manually. The reductions were entered into an analysis spreadsheet and estimated emissions effects were calculated.

Cost Methodology:

This measure is a public information program to reduce cold starts affecting personal travel. It was assumed that the public information program would cost $750,000 annually with most of the cost for producing and distributing audio, video and text materials.

33

CALIFORNIA CARS

Definition:

This TCM would implement the California program requirements (emissions standards and fleet make up).

Travel and Emissions Analysis:

Assumptions:

- Only emissions rates will be affected. No changes in travel will result.

Procedure:

Appropriate changes were made to the MOBILE5a setup and the resulting emissions were calculated.

Cost Methodology:

This measure would most likely be implemented after 1996. The cost to achieve the emissions reduction assumes that the first year of implementation would be 1996 model year cars and that 10% of the registered autos will be purchased in model year 1996 and that 10% of the new cars purchased would be California low emissions vehicles (LEV). The private cost per LEV used was $205 per vehicle.

34

FEEBATE ON PURCHASE OF NEW CAR

Definition:

This TCM encourages consumers to purchase new cars with higher efficiency characteristics. Specifically, it would evaluate the EPA test case of placing a fee on the purchase of vehicles with poor MPG, with a maximum of $1364 on vehicles attaining no more than 21 mpg, and a maximum rebate of $395 on 45 mpg vehicles.

Upon further discussion, the definition of this TCM has been revised to reflect a feebate schedule that induces emissions improvements rather than MPG. Indeed, vehicles with higher fuel economy may well produce higher emissions.

Travel and Emissions Analysis:

The feebate schedule is the same as that used by EPA in their 1991 study:

MPG	Fee/(Rebate)	MPG	Fee/Rebate
45	$(395)	31	$472
43	(286)	29	621
41	(173)	27	781
39	(56)	25	960
37	55	23	1154
35	193	21	1364
33	329		

Source: Meeting Mobility and Air Quality Goals: Strategies that Work (EPA, Office of Policy Analysis, January 1993)

Assume that the fee structure will be linked to emissions instead of MPG. The fee system applied to emissions is estimated to produce an improvement in average MPG for current model year cars from 27 in 1991 to 33 in 2000, an improvement of 22.2% This translates to a 2.2% per year improvement; we assume the same improvement would translate to emissions.

Thus: were this system to be instituted in 1995, then 1995 model year cars would be 2.2% cleaner than they would have been otherwise, and 1996 model year cars would be 4.4% cleaner. To evaluate impact on regional emissions, adjust the emissions factors in MOBILE to reflect these improvements for this portion of the stock.

Cost Methodology:

This measure provides a rebate to the purchase of new cars that are lower in emissions than the regular new car standard. The new cars that produce higher levels of emissions would be charged a fee (tax). The program would be established to pay for itself except for the administration fee. This fee was estimated to be $500,000 annually.

35

COMPREHENSIVE GAS TAX

Definition:

This TCM is defined as a comprehensive regional gas tax of $0.84 per gallon.

Travel and Emissions Analysis:

Evaluation was made with the DVRPC regional mode choice model applied to both work and non-work travel. The cost increase per gallon was translated to a cost per mile through assumption of a 21 mpg per average vehicle (then deflated by 0.58 time inflation factor).

Revised trip tables will be run through network assignment and then PPAQ for emissions estimation.

Cost Methodology:

This measure would increase gasoline taxes by $0.84 per gallon. The number of gallons consumed was calculated assuming a 21 miles per gallon average vehicle fleet rate and proportioned from the VMT tax of 4 cents per mile. An administration cost of $750,000 was assumed for collection of additional tax and auditing the tax collection program.

36

VEHICLE MILES TRAVELLED (VMT) TAX

Definition:

This TCM would impose a 4 cents tax per mile on all Vehicle Miles of Travel (VMT). The effect should be to decrease VMT by encouraging a shift to higher-occupancy modes, reducing the frequency and distance of travel, and possibly even causing a shift to more efficient vehicles.

Travel and Emissions Analysis:

This analysis will be performed in the same manner as the gas tax, through the DVRPC mode choice model, followed by assignment and PPAQ emissions model.

Auto operating cost was increased by 4 cents per mile in the travel skims, and the mode choice model run on such a difference in cost for both work and non-work travel. Revised trip tables were run through assignment and PPAQ.

Cost Methodology:

This measure would impose a four cents per mile tax on all vehicle miles travelled. The administration costs were assumed to be $1,000,000 to collect the vehicle mileage at the time of state inspection and to bill the owner.

FACILITY PRICING

37

Definition:

This TCM would double the current tolls for all vehicles getting both on and off the PA Turnpike (I-276) between the Route 100 and Route 1 interchanges, and the Northeast Extension (PA 9) from its origin to the interchange at Quakertown, during the AM peak period (6:30 to 9:00) and the PM peak period (4:00 to 6:30). (The measure would be complementary to the Cross-County Metro, if and when it is built.)

Travel and Emissions Analysis:

This measure was analyzed by DVRPC by adjusting the toll links in question to have a greater impedance and re-running the assignment and emissions models. The links were identified, and the assignment was re-run without re-running the mode choice/distribution model (thus, no effect on VMT).

Cost Methodology:

This measure would result in increased revenues from higher SOV tolls, which would then be used to cover reduced tolls for HOV users plus increased administrative costs. It is assumed that the toll structure will be adjusted to just cover the costs/subsidy increases, thus the program will operate *revenue neutral*.

3 RESULTS

The analysis clearly reveals that certain types of strategies are more effective than others. Of the 37 strategies tested, the pricing measures ($.84 gas tax, $.04 per VMT tax, $3/day regional parking charge, and $3/day parking tax in the CBD) show the most emissions reduction potential and are the most cost-effective (in fact, these strategies are revenue-producing). Also exhibiting high emissions reduction potential and cost-effectiveness are the ETRP and related strategies, educational efforts, and low-emission vehicles/fuels. Transit capital improvements, such as rail service extensions and restorations, have the lowest emission reduction potential and the lowest near-term cost-effectiveness. The analysis highlights various types of strategies that could be classified as moderately effective, including bicycle improvements, advanced signal system improvements, ramp metering, limits on new parking facilities, and removing pre-1980 vehicles.

When comparing the effectiveness of the measures using the figures presented below, it is important to also be familiar with the project definition and scope provided in the worksheets. The test scenarios vary greatly in scale and are not always directly comparable. Some of the sample applications are applied region-wide and have a greater potential for impact than do those which are more localized.

The results of the analysis are presented in the following summary tables. Keep in mind that the figures are estimates and not precise measurements.

Table 6 provides the travel and emissions impacts for each test scenario for an average summer weekday. Changes in vehicle trips and transit trips for home-based work travel and total travel are given along with changes in vehicle miles of travel. The change in emissions is shown in kilograms for VOC, CO, and NO_x.

Table 7 summarizes costs. Annual public sector and private sector costs and revenues are given, along with total cost-effectiveness in dollars per vehicle miles of travel reduced and dollars per ton of emissions reduced.

Table 8 groups the test scenarios by strategy type and provides their changes in annual VMT and emissions, and their cost-effectiveness. This purpose of this table is to highlight the range of impact and effectiveness within a particular class of strategies.

Table 9 ranks the measures in order of their annual emissions reduction while Table 10 ranks them by total cost-effectiveness.

Table 11 is a matrix categorizing each measure according to its emissions reduction potential and its cost-effectiveness. The emissions reduction levels are listed in the far left column and range from more than 1,000 annual tons reduced to 1 to 10 annual tons reduced. Cost-effectiveness levels are shown across the top row of the table and range from revenue-producing to more than $100,000 per ton. Each TCM that was tested is placed in the appropriate box. The measures with the most

emissions reduction potential and the highest cost-effectiveness fall into the upper left corner of the table, while the ones with the least emissions reduction potential and the lowest cost-effectiveness fall into the lower right corner.

Table 6
Travel and Emissions Impact Summary for an Average Summer Weekday

		CHANGE IN HOME-BASED WORK TRAVEL		CHANGE IN TOTAL TRAVEL		CHANGE IN TOTAL VMT	CHANGE IN EMISSIONS		
		Vehicle Trips % Change	Transit Trips % Change	Vehicle Trips % Change	Transit Trips % Change	Veh-Miles % Change	kg of VOC % Change	kg of CO % Change	kg of NO_x % Change
	1996 Base Condition 5-County PA Region Only	2,066,000 (a)	456,000 (a)	10,092,000 (a)	764,000 (a)	71,701,500 (b,c)	79,500 (b)	510,500 (b)	111,000 (b)
ID #	Test Scenario								
	TRAFFIC FLOW IMPROVEMENTS								
1	Advanced signal systems on 50 miles of the most congested 4-lane arterials	Not Calculated	Not Calculated	Not Calculated	Not Calculated	-70,544 -0.1	-135 -0.2	-545 -0.1	-145 -0.1
2	Advanced signal system improvements - Comprehensive system for Philadelphia CBD	Not Calculated	Not Calculated	Not Calculated	Not Calculated	-7,336 -0.0	-32 -0.0	-227 -0.0	-25 -0.0
3	Congestion and incident management systems on interstates within Philadelphia and the four suburban counties	Not Calculated	Not Calculated	Not Calculated	Not Calculated	+12,472 0.0	-149 -0.2	-638 -0.1	6 0.0
4	Ramp metering	Not Calculated	Not Calculated	Not Calculated	Not Calculated	-43,216 -0.1	-374 -0.5	-3,159 -0.6	-31 -0.0

		CHANGE IN HOME-BASED WORK TRAVEL		CHANGE IN TOTAL TRAVEL		CHANGE IN TOTAL VMT	CHANGE IN EMISSIONS		
		Vehicle Trips % Change	Transit Trips % Change	Vehicle Trips % Change	Transit Trips % Change	Veh-Miles % Change	kg of VOC % Change	kg of CO % Change	kg of NO_x % Change
	1996 Base Condition 5-County PA Region Only	2,066,000 (a)	456,000 (a)	10,092,000 (a)	764,000 (a)	71,701,500 (b,c)	79,500 (b)	510,500 (b)	111,000 (b)
ID #	Test Scenario								
5	Enforce adherence to 55 mph speed limit on PA Turnpike	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	-161 -0.2	-5,230 -1.0	-567 -0.5
	TRANSIT OPERATIONS								
6	Restoration of service on regional rail lines	-1,000 -0.0	1,267 0.3	-1,255 -0.0	1,998 0.3	-10,360 -0.0	-10 -0.0	-61 -0.0	-18 -0.0
7	Extension of Route 66 trackless trolley	-154 -0.0	171 0.0	-278 -0.0	364 0.0	-1,360 -0.0	-2 -0.0	-10 -0.0	-3 -0.0
8	Improvement to express service on regional rail lines	-368 -0.0	466 0.1	-505 -0.0	731 0.1	-14,752 -0.0	-14 -0.0	-87 -0.0	-26 -0.0
9	Systemwide fare reductions of 10%	-4,693 -0.2	5,505 1.2	-9,497 -0.1	13,164 1.7	-73,488 -0.1	-84 -0.1	-506 -0.1	-118 -0.1
10	Systemwide fare reductions of 20%	-8,275 -0.4	9,696 2.1	-16,762 -0.2	23,473 3.1	-144,016 -0.2	-178 -0.2	-977 -0.2	-238 -0.2
11	Systemwide fare reductions of 50%	-19,970 -1.0	23,409 5.1	-42,071 -0.4	58,884 7.7	-362,432 -0.5	-425 -0.5	-2,460 -0.5	-622 -0.6
12	Improve suburban bus service	-5,373 -0.3	6,161 1.4	-7,248 -0.1	9,216 1.2	-54,000 -0.1	-61 -0.1	-393 -0.1	-92 -0.1